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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/538,064	03/07/2006	Masanobu Honda	033082M257	9221

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EXAMINER	
ANGADI, MAKI A	

ART UNIT	PAPER NUMBER
1792	

MAIL DATE	DELIVERY MODE
10/17/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/538,064	HONDA ET AL.	
	Examiner	Art Unit	
	Maki A. Angadi	1765	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *09 August 2007*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-8 and 14-16* is/are pending in the application.

4a) Of the above claim(s) *9-13* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-8 and 14-16* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 8/9/2007 has been entered.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35

U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

1. Claims 1 and 2, are rejected under 35 U.S.C. 103(a) over Nakaune (US Pub. 2003/0080091) in view of Hasegawa (US Patent No. 6,593,246) and Ono, Pure and Applied Chemistry, Vol.66, No.6, (1994).

As to claims 1, Nakaune discloses a method and an apparatus that reads on plasma etching an organic material (paragraph 0004) by means of a parallel plate type plasma etching apparatus (Fig.1) (paragraph 0013); wherein the organic material films is plasma-etched (paragraph 0004 0006) with; a high frequency power of a frequency in the range of 300MHz to 1GHz (paragraph 0014); and a process gas including an accelerating gas that is ionized with an ionization energy of about 0.025 eV to 1eV (paragraph 0014) and a molecular gas (paragraph 0020).

Nakaune does not expressly cite the use of an inorganic material film as a mask. However, Hasegawa discloses the plasma etching of an organic material film formed on a substrate with an inorganic material film used as mask (col.4, lines 65-67 and col.9, lines 4-15). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to select an inorganic material film as a mask in the process used by Nakaune because Hasegawa illustrates that by using inorganic film as a mask one can minimize

damage to the low dielectric constant organic film in the step of removing the resist (col.2, lines 64-67).

Nakaune fails to disclose the ionization cross section of the accelerating process gas. However, Ono discloses the ionization cross section of the process gas molecules in the range $2x10^{-6}$ cm^2 to about 10^{-19} cm^2 for Cl_2 in the plasma etching process (Fig.4, page 1331). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to select ionization cross section of molecular gas in the plasma etching process used by Nakaune because Ono illustrates that ionization cross section of molecular gas in the etching plasma determine the etching characteristics such as etch rate, ion and electron energies and plasma densities (page 1327, second paragraph).

Nakaune fails to disclose a flow ratio of the ionization gas relative to the molecular gas. However, Hasegawa discloses the ratio of the ionization gas such as argon (240 cm^3/min) to the molecular gas carbon monoxide ((180cm^3/min) being greater than 0.5 or above for low dielectric organic film (col.9, lines 37-47). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to select the flow-ratio of the gases in the plasma etching process employed by Nakaune because Hasegawa illustrates the need for using a mixture of gases in depositing low-k dielectric organic films in conjunction with other high-k materials (col.6, lines 58-67).

As to claim 2, Nakaune discloses a plasma etching apparatus that includes a process vessel into the which the process gas is supplied (paragraph 0013 and 0020); and parallel plate electrodes disposed in the process vessel (paragraph 0022), the electrodes being constituted by a support electrode that is opposed to the support electrode, and a counter electrode that is opposed to the support electrode (paragraphs 0020 and 0022); and the high frequency power for generating the plasma is applied to the support electrode (paragraph 0020).

As to claim 15, Nakaune discloses the use of argon (paragraph 0024) and helium (paragraph 0022), N_2 and H_2 (paragraph 0020) in the etching process. One who is skilled in the art should be able to select the ratio of Ar relative to N_2 and H_2 because Nakaune illustrates that the gas mixture in the plasma reactor controls the etching rate (paragraph 0028).

Claim Rejections - 35 USC § 103

3. Claims 3-8 are rejected under 35 U.S.C. 103(a) over Nakune (US Pub. 2003/0080091) in view of Hasegawa (US Patent No. 6,593,246) and Ono, Pure and Applied Chemistry, Vol.66, No.6, (1994) as applied to claim 1 and 2, in further view of Ohmi (US Patent No. 5,272,417).

As to claim 3, Nakaune discloses the use of high frequency power in the range of 300 MHz to 1 GHz, but fails to disclose using self-bias voltage of the

support electrode. However, Ohmi discloses the use of self-bias of the electrode of about 400 V (col.3, lines 3-9), which is lower than 500 V used by the applicant. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to select self-bias voltage for the electrode used by Nakaune because Ohmi illustrates that applying self-bias voltage to the electrode leads acceleration of ions by the potential based on the difference between the self bias voltage and the plasma potential (col.1, lines 42-50).

As to claim 4, see the arguments with respects to claims 2 and 3.

As to claim 5, Nakaune discloses the molecular gas N_2 and H_2 but fails to disclose the process gas argon as the ionization accelerating gas. However, Ohmi discloses using argon as the ionization accelerating gas (col.3, lines 11-12). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to select argon as ionization gas in the etching process used by Nakaune because Ohmi illustrates that argon gas being an inert gas one can generate plasma with high concentration and to increase the throughput (col.3, lines 30-33).

As to claim 6, Nakaune discloses the use of argon as a process gas but fails to disclose the use of ammonia as the molecular gas. However, Hasegawa discloses the use of ammonia as the molecular gas (col.9, lines 51-55).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to select ammonia as molecular gas in the plasma etch process used by Nakaune because Hasegawa illustrates that the molecular gas such as ammonia is useful to etch low dielectric constant organic film (col.9, lines 53-55).

As to claim 7, Nakaune discloses a frequency of the high-frequency power for generating the plasma is in the range 300 MHz to about 1GHz (paragraph 0014) that is higher than the value cited by the applicant. The frequency of the plasma source is an experimental parameter, which is adjusted to meet the etching conditions and the plasma density. Therefore, it would have been obvious to one ordinary skill in the art at the time the invention was made to select plasma frequency that is required for plasma etching of organic material. One who is skilled in the art would be motivated to optimize through routine experimentation of changing frequency values. See MPEP § 2144.05 II.

As to claim 8, Nakaune discloses the distance between the support electrode and the counter electrode in the parallel plate electrode is between 50 mm to 100 mm (paragraph 0019), which is lower than the range (<40 nm) cited by the applicant. The distance between the parallel plate electrode is dependent on several parameters such as rate of etching, chamber geometry, pressure in the chamber and etching gases used in the process. Therefore, it would have

been obvious to one of ordinary skill n the art at the time the invention was made to adjust the distance between electrodes to achieve the desired etch rate. One who is skilled in the art would be motivated to optimize distance between parallel plates through routine experimentation. See MPEP § 2144.05 II

Claim Rejections - 35 USC § 103

4. Claim 14 rejected under 35 U.S.C. 103(a) over Nakaune (US Pub. 2003/0080091) in view of Fuse (US Pub.No. 2004/0206725), Hasegawa (US Patent No. 6,593,246) and Ono, Pure and Applied Chemistry, Vol.66, No.6, (1994).

Nakaune discloses a method and an apparatus that reads on plasma etching an organic material (paragraph 0004) by means of a parallel plate type plasma etching apparatus (Fig.1) (paragraph 0013); wherein the organic material films is plasma-etched (paragraph 0004 0006) with; a high frequency power of a frequency in the range of 300MHz to 1GHz (paragraph 0014); and a process gas including an accelerating gas that is ionized with an ionization energy of about 0.025 eV to 1eV (paragraph 0014) and a molecular gas (paragraph 0020).

Nakaune does not expressly cite the use of an inorganic material film as a mask. However, Hasegawa discloses the plasma etching of an organic material film formed on a substrate with an inorganic material film used as mask (col.4, lines 65-67 and col.9, lines 4-15). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to select an

inorganic material film as a mask in the process used by Nakaune because Hasegawa illustrates that by using inorganic film as a mask one can minimize damage to the low dielectric constant organic film in the step of removing the resist (col.2, lines 64-67).

Nakaune fails to disclose the ionization cross section of the accelerating process gas. However, Ono discloses the ionization cross section of the process gas molecules in the range $2x10^{-6}$ cm^2 to about 10^{-19} cm^2 for Cl_2 in the plasma etching process (Fig.4, page 1331). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to select ionization cross section of molecular gas in the plasma etching process used by Nakune because Ono illustrates that ionization cross section of molecular gas in the etching plasma determine the etching characteristics such as etch rate, ion and electron energies and plasma densities (page 1327, second paragraph).

Nakaune discloses RF power frequency power in the range of about 300 MHz to 1GHz (paragraph 0014) but fails to disclose the range cited by the applicant. However, Fuse discloses the use of high frequency power supply that supplies RF power of about 60 MHz for generating plasma, which covers the range cited by the applicant (paragraph 0039, 0046)). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to select a lower RF frequency for etching organic film because Fuse illustrates that one can achieve high etching uniformity and efficiency with higher RF power (paragraph 0059).

Nakaune fails to disclose a flow ratio of the ionization gas relative to the molecular gas. However, Hasegawa discloses the ratio of the ionization gas such as argon (240 cm^3/min) to the molecular gas carbon monoxide ((180cm^3/min) being greater than 0.5 or above for low dielectric organic film (col.9, lines 37-47). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to select the flow-ratio of the gases in the plasma etching process employed by Nakaune because Hasegawa illustrates the need for using a mixture of gases in depositing low-k dielectric organic films in conjunction with other high-k materials (col.6, lines 58-67).

Claim Rejections - 35 USC § 103

5. Claim 16 is rejected under 35 U.S.C. 103(a) over Nakaune (US Pub. 2003/0080091) in view of Hasegawa (US Patent No. 6,593,246) and Ono, Pure and Applied Chemistry, Vol.66, No.6, (1994) as applied to claim 1 above, and in further view of Ho (US Pub.No. 2002/0108929).

Nakaune discloses the use of Ar gas (paragraph 0024) in the etching process but is silent about the use of NH_3 gas. However, Ho discloses the use of Ar (paragraph 0060) and NH_3 (paragraph 0066) gases in the etching of low-k dielectrics with a flow ratio of 2 to 3. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to select the flow ratio of gases because Ho illustrates the use of several gases to improve etch rates and selectivity of low-dielectric layers (paragraph 0032).

Response to Arguments

6. Applicant's arguments filed on 8/9/2007 have been fully considered but they are not persuasive.

(a) With respect to claim 1, applicants' arguments on pages 7-8 of the reply asserting that the combined reference of Nakaune, Hasegawa and Ono fail to disclose the ionization energy of 10 eV are not convincing. The secondary prior art of Ono discloses the ionization energy in the case of chlorine gas (Table 1, Fig. 2C) used in the plasma etching process. With regard to ionization cross section of molecular gas the teachings of Ono applicable to electron-impact processes in chlorine gas is applicable to other substrate materials. The ionization cross-section is primarily controlled by the type molecular gas and RF power used in the plasma chamber.

(b) With respect to claims 2 and 3, applicant's arguments on page 8 of the reply asserting that Nakaune does not teach generating the plasma by applying a high-frequency power to the substrate are not convincing. It is within the inventive scope of one who is skilled in the art at time of the invention to rearrange the position of support electrode to meet the requirement of plasma etching process as is illustrated in the second reference of Ohmi.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Maki A. Angadi whose telephone number is 571-272-8213. The examiner can normally be reached on 8 AM to 4.30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine G. Norton can be reached on 571-272-1465. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Dr. Maki Angadi
Examiner,
Art Unit 1765

LAN VINH
PRIMARY EXAMINER